



Character Recognition System Using Back Prorogation Network

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Abstract— *In this paper, we present a new neural network based method for optical character recognition as well as handwritten character recognition. Experimental results show that our proposed method achieves Increased accuracy in optical character recognition As well as handwritten character recognition. We present an overview of existing handwritten character recognition techniques. All these algorithms are described more or less on their own. Handwritten character recognition is a very popular and computationally expensive task. We also explain the fundamentals of handwritten character recognition. We describe today’s approaches for handwritten character recognition. From the broad variety of efficient techniques that have been developed we will compare the most important ones. We will systematize the techniques and analyze their performance based on both their run time performance and theoretical considerations. Their strengths and weaknesses are also investigated. It turns out that the behavior of the algorithms is much more similar as to be expected.*

Keywords— *OCR, HCR, BPN, Patten Recognition, Neural Network etc.*

I. Introduction

Character recognition is an art of detecting segmenting and identifying characters from image. More precisely Character recognition is process of detecting and recognizing characters from input image and converts it into ASCII or other equivalent machine editable form[1], [2], [3]. It contributes immensely to the advancement of automation process and improving the interface between man and machine in many applications [4]. Character recognition is one of the most interesting and fascinating areas of pattern recognition and artificial intelligence [5], [6]. Character recognition is getting more and more attention since last decade due to its wide range of application. Conversion of handwritten characters is important for making several important documents related to our history, such as manuscripts, into machine editable form so that it can be easily accessed and pres independent work is going on in Optical Character Recognition that is processing of printed/computer generated document and handwritten and manually created document processing i.e. handwritten character recognition. Character recognition offline character recognition (Fig. 1(a)) and online character recognition (Fig. 1(b)).

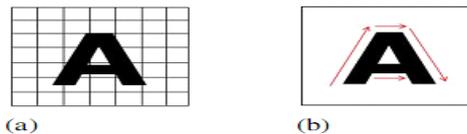


Figure1.(a)Offline character recognition; (b)Online character recognition

In offline character recognition system, document is first generated, digitized, stored in computer and then it is processed. While in case of online character recognition system, character is processed while it was under creation. External factors like pressure speed of writing have any influence in case of offline system but they have great impact on online system. Again, offline or online system can be applied on optical character (Fig 2.(a)) or handwritten characters (Fig 2.(b)).Based on that system can be classified as OCR or HCR respectively. The online methods have been superior to their counterpart i.e. offline methods due to temporal information present in character generation [4].

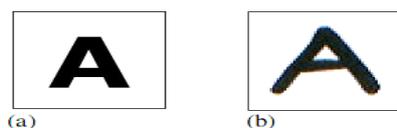


Figure2.(a)Optical character ; (b)Handwritten character

Accuracy of HCR is still limited to 90 percent due to presence of large variation in shape, scale, style, orientation etc. [8]. Character processing systems are domain and application specific, like there it is not possible to design generic system which can process all kind of scripts and language. Lots of work has been done on European languages and Arabic (Urdu)

language. Whereas domestic languages like Hindi, Punjabi, Bangla, Tamil, Gujarati etc. are very less explored due to limited usage. In this paper, our focus is to carry out in depth literature survey on handwritten character recognition methods.

Three main application areas of OCR are commonly distinguished as; data entry, text entry and process automation.

- Data Entry:-This area covers technologies for entering large amounts of restricted data. Initially such document reading machines were used for banking applications. The systems are characterized by reading only an extremely limited set of printed characters, usually numerals and a few special symbols. They are designed to read data like account numbers, customer's identification, article numbers, amounts of money etc.
- Text Entry:-The second branch of reading machines is that of page readers for text entry, mainly used in office automation. Here the restrictions character set is exchanged for con-straints concerning font and printing quality. The read-ing machines are used to enter large amounts of text, of-ten in a word processing environment. These page rea ders are in strong competition with direct key-input and electronic exchange of data. This area of application is therefore of diminishing importance.
- Process Automation: -This is actually the technology of automatic address reading for mail sorting. Hence, the goal is to direct each letter into the appropriate bin regardless of whether each character was correctly recognized or not.

Image processing and pattern recognition plays significant role in handwritten character recognition. In [10], Rajbala et al have discussed various types of classification of feature extraction methods like statistical feature based methods, structural feature based methods and global transformation techniques. Statistical methods are based on planning of how data are selected. It uses the information of statistical distribution of pixels in image. It can be mainly classified in three categories: 1). Partitioning in regions, 2). Profile generation and projections 3). Distances and crossing. Structural features are extracted from structure and geometry of character like number of horizontal and vertical lines, aspect ratio, number of cross points, number of loops, number of branch points, number of strokes, number of curves etc. Global transformation features are calculated by converting image in frequency domain like Discrete Fourier Transformation (DFT), Discrete Cosine Transformation (DCT), Discrete Wavelet Transformation (DWT), Gabor filtering, Walsh-Hadamard transformation etc.

Feature extracted can be either low level or high level. Low level features include width, height, curliness, aspect ratio etc of the character. These alone cannot be used to distinguish one character from another in the character set of the language [11]. So, there are a number of other high level features which include number and position of loops, straight lines, headlines, curves etc. Tirthraj Dash et al have discussed HCR using associative memory net (AMN) in their paper [12]. They have directly worked at pixel level. Dataset was designed in MS Paint 6.1 with normal Arial font of size 28. Dimension of image was kept 31 X 39. Once characters are extracted, their binary pixel values are directly used to train AMN. I.K.Pathan et al have proposed offline approach for handwritten isolated Urdu characters in their wok mentioned in [13]. Urdu character may contain one, two, three or four segment. In which one component is known as primary (generally represents large continuous stroke) and rest of all are known as secondary components (generally represents small stroke or dots). Authors have used moment invariants (MI) feature to recognize the characters. MI features are well known to be invariant under rotation, translation, scaling and reflection. MI features are measure of the pixel distribution around the center of gravity of character and it captures the global character shape information. If character image is single component than it is normalized in 60 X 60 pixels and horizontally divided in equal 3 parts. 7 MI are extracted from each zone and 7 MI are calculated from overall image, so total of 28 features are used to train SVM. And if image is having multi component than 28 MI are extracted from primary component (60 X 60) and 21 MI are extracted from secondary component (22 X 22). Separate SVM are trained for both and decision is taken based on rules satisfying some criteria. Proposed system claim to get highest 93.59 % accuracy. In [4], Pradeep et al have proposed neural network based classification of handwritten character recognition system. Each individual character is resized to 30 X 20 pixels for processing. They are using binary features to train neural network. However such features are not robust. In post processing stage, recognized characters are converted to ASCII format. Input layer has 600 neurons equal to number of pixels. Output layer has 26 neurons as English has 26 alphabets. Proposed ANN uses back propagation algorithm with momentum and adaptive learning rate.

II. Artificial Neural Network

A neural network is a powerful data modeling tool that is able to capture and represent complex input/output relationships. The motivation for the development of neural network technology stemmed from the desire to develop an artificial system that could perform "intelligent" tasks similar to those performed by the human brain.

Neural networks resemble the human brain in the following two ways: (1) A neural network acquires knowledge through learning; (2) A neural network's knowledge is stored within inter-neuron connection strengths known as synaptic weights.

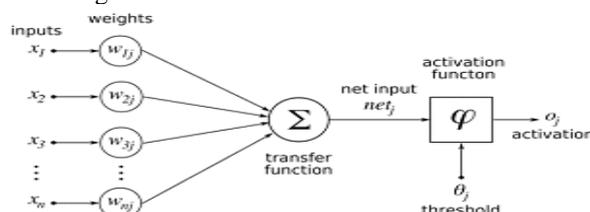


Figure3: Structure of ANN

The most common neural network model is the multilayer perceptron (MLP). This type of neural network is known as a supervised network because it requires a desired output in order to learn. The goal of this type of network is to create a model that correctly maps the input to the output using historical data so that the model can then be used to produce the output when the desired output is unknown. A graphical representation of an MLP is shown below.

III. COMPONENTS OF OCR SYSTEM

- **Optical scanning:-**

Through the scanning process a digital image of the original document is captured. In OCR optical scanners are used, which generally consist of a transport mechanism plus a sensing device that converts light intensity into gray-levels. Printed documents usually consist of black print on a white background. Hence, when performing OCR, it is common practice to convert the multilevel image into a bi-level image of black and white. Often this process, known as thresholding, is performed on the scanner to save memory space and computational effort.

- **Location and segmentation:-**

Segmentation is a process that determines the constituents of an image. It is necessary to locate the regions of the document where data have been printed and distinguish them from figures and graphics. For instance, when performing automatic mail-sorting, the address must be located and separated from other print on the envelope like stamps and company logos, prior to recognition.

- **Pre-processing:-**

The image resulting from the scanning process may contain a certain amount of noise. Depending on the resolution on the scanner and the success of the applied technique for thresholding, the characters may be smeared or broken. Some of these defects, which may later cause poor recognition rates, can be eliminated by using a pre-processor to smooth the digitized characters.

- **Feature extraction:-**

The objective of feature extraction is to capture the essential characteristics of the symbols, and it is generally accepted that this is one of the most difficult problems of pattern recognition. The most straight forward way of describing a character is by the actual raster image. Another approach is to extract certain features that still characterize the symbols, but leaves out the unimportant attributes.

Post processing: -

Post processing are two types-

1. Grouping
2. Error-detection and correction

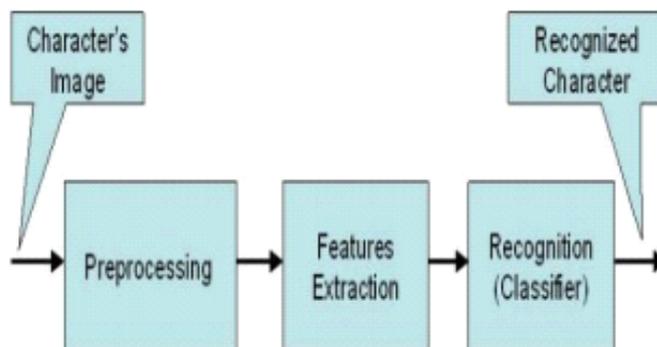


Figure4:Component of OCR

IV. Proposed System

Aim of the proposed system is to develop a neural network based method for accurate optical character recognition. The algorithm will learn from the training data set and will provide 100 percent accurate optical character recognition result. Here we develop a neural network based method for accurate handwritten character recognition.

OCR is the acronym for Optical Character Recognition. This technology allows a machine to automatically recognize characters through an optical mechanism. Human beings recognize many objects in this manner our eyes are the "optical mechanism." But while the brain "sees" the input, the ability to comprehend these signals varies in each person according to many factors. By reviewing these variables, we can understand the challenges faced by the technologist developing an OCR system. The ultimate objective of any OCR system is to simulate the human reading capabilities so the computer can read, understand, edit and do similar activities it does with the text. Block diagram of the typical OCR system. Each stage has its own problems and effects on the overall system's efficiency. Thus, to tackle the problems, either by solving each particular problem.OCR system by integrating all stages to one main stage, and this is what our research proposes. This thesis presents new structure of OCR system which relies on the powerful proprieties. The algorithm is designed and tested in the related sections.

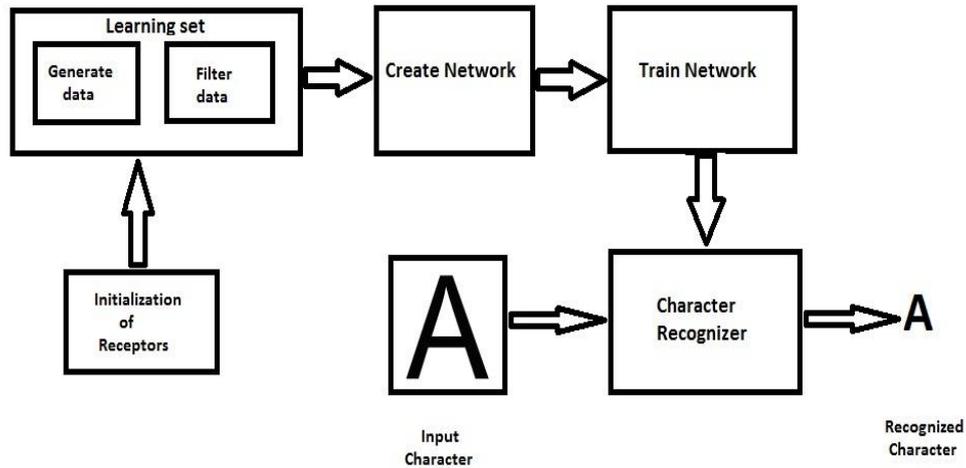


Figure5: structure of the proposed system

V. PROPOSED ALGORITHM

- The input pattern is presented to the input layer of the network
- These inputs are propagated through the network until they reach the output units.
- This forward pass produces the actual or predicted output pattern. Because back propagation is a supervised learning algorithm, the desired outputs are given as part of the training vector.
- The actual network outputs are subtracted from the desired outputs and an error signal is produced.
- This error signal is then the basis for the back propagation step, whereby the errors are passed back through the neural network by computing the contribution of each hidden processing unit and deriving the corresponding adjustment needed to produce the correct output.
- The connection weights are then adjusted and the neural network has just “learned” from an experience. Once the network is trained, it will provide the desired output for any of the input patterns.
- The network undergoes supervised training, with a finite number of pattern pairs consisting of an input pattern and a desired or target output pattern.
- An input pattern is presented at the input layer. The neurons here pass the pattern activations to the next layer neurons, which are in a hidden layer.
- The outputs of the hidden layer neurons are obtained by using perhaps a bias, and also a threshold function with the activations determined by the weights and the inputs. These hidden layer outputs become inputs to the output neurons, which process the inputs using an optional bias and a threshold function.
- The final output of the network is determined by the activations from the output layer.
- The computed pattern and the input pattern are compared, a function of this error for each component of the pattern is determined, and adjustment to weights of connections between the hidden layer and the output layer is computed.
- A similar computation, still based on the error in the output, is made for the connection weights between the input and hidden layers.
- The procedure is repeated with each pattern pair assigned for training the network.
- Each pass through all the training patterns is called a cycle or an epoch. The process is then repeated as many cycles as needed until the error is within a prescribed tolerance.
- The adjustment for the threshold value of a neuron in the output layer is obtained by multiplying the calculated error in the output at the output neuron and the learning rate and momentum parameter used in the adjustment calculation for weights at this layer.
- After a network has learned the correct classification for a set of inputs from a training set, it can be tested on a second set of inputs to see how well it classifies untrained patterns.

VI. RESULT

We take 3 characters with its 5 pattern and examine that character set.

Character	No. of patterns given	Recogniti on	Not Recognized	Rate (%) of Recognition
L	5	5	0	100%
M	5	5	0	100%
O	5	5	0	!00%

Figure6: Experimental Result of OCR System

VII. Conclusion

In this Paper we surveyed a large number of methods of optical character recognition. We analyzed the advantages and drawbacks of various OCR methods. We also proposed a modified back propagation method. It is used in neural network. The proposed method computes error rate efficiently. It results in increasing the accuracy of neural network. Our proposed neural network based method is providing 100 percent accuracy in OCR.

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